ICESat observations of seasonal and interannual variations of sea-ice freeboard and estimated thickness in the Weddell Sea, Antarctica (2003–2009)

Donghui YI,[1] H. Jay ZWALLY,[2] John W. ROBBINS[1]

[1]*SGT Inc., Cryospheric Sciences Branch, NASA Goddard Space Flight Center, Code 614.1, Greenbelt, MD 20771, USA*
E-mail: donghui.yi@nasa.gov
[2]*Cryospheric Sciences Branch, NASA Goddard Space Flight Center, Code 614.1, Greenbelt, MD 20771, USA*

ABSTRACT. Sea-ice freeboard heights for 17 ICESat campaign periods from 2003 to 2009 are derived from ICESat data. Freeboard is combined with snow depth from Advanced Microwave Scanning Radiometer for Earth Observing System (AMSR-E) data and nominal densities of snow, water and sea ice, to estimate sea-ice thickness. Sea-ice freeboard and thickness distributions show clear seasonal variations that reflect the yearly cycle of growth and decay of the Weddell Sea (Antarctica) pack ice. During October–November, sea ice grows to its seasonal maximum both in area and thickness; the mean freeboards are 0.33–0.41 m and the mean thicknesses are 2.10–2.59 m. During February–March, thinner sea ice melts away and the sea-ice pack is mainly distributed in the west Weddell Sea; the mean freeboards are 0.35–0.46 m and the mean thicknesses are 1.48–1.94 m. During May–June, the mean freeboards and thicknesses are 0.26–0.29 m and 1.32–1.37 m, respectively. The 6 year trends in sea-ice extent and volume are $(0.023 \pm 0.051) \times 10^6\,\mathrm{km^2\,a^{-1}}$ $(0.45\%\,\mathrm{a^{-1}})$ and $(0.007 \pm 0.092) \times 10^3\,\mathrm{km^3\,a^{-1}}$ $(0.08\%\,\mathrm{a^{-1}})$; however, the large standard deviations indicate that these positive trends are not statistically significant.